South Weymouth Naval Air Station

Weymouth, MA

Geophysical Data Report

Electromagnetic, Magnetic, and Seismic Refraction Surveys

FINAL REPORT

7 December 2004

Submitted by:

Stone & Webster, Inc.
100 Technology Center Drive
Stoughton, MA 02072

Shaw® Shaw Environmental, Inc.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

BGS .... Below ground surface
EM .... Electromagnetic
EM31/EM31-MK2 Geonics Model EM-31 Terrain Conductivity Meter
fps .... feet per second
G858 .... Geometrics G858 Cesium Vapor Magnetometer
GPS .... Global Positioning System
MAG..................... Magnetometry
mS/m .... milliSiemens/meter
mV .... millivolts
NAD83 .... North American Survey Datum 1983
QA/QC .... quality assurance/quality control
Shaw .... Shaw Environmental, Inc
SWNAS................ South Weymouth Naval Air Station

1.0 INTRODUCTION

This report summarizes the work and results from the geophysical investigations that were performed at the South Weymouth Naval Air Station (SWNAS) in Weymouth, Massachusetts during early part of October 2004. Shaw Environmental Inc. (Shaw), Geophysics Group, acquired magnetic (MAG) electromagnetic (EM), and seismic refraction data at a site designated as Area of Concern 108 – the former Naval Reserve Bivouac Area.

This report contains sections describing instrumentation, field procedures, data processing methods, and geophysical survey results and interpretation of the magnetic, electromagnetic and seismic refraction survey data. This report will be delivered electronically as part of a project CD-ROM. Survey results maps are plotted in Massachusetts – Mainland State Plane coordinates, with units of meters, using the 1983 North American Survey Datum (NAD83).

1.1 Magnetic and Electromagnetic Surveys

The objective of the MAG and EM surveys was to locate any potential buried metallic objects such as drums, which may be sources for subsurface contamination. The magnetic and EM surveys were performed in an area of approximately 300 feet by 400 feet adjacent to the south side of Pigeon Road.

1.2 Seismic Refraction Survey

The seismic refraction work was mainly performed to map the bedrock topography, and, if possible, assess the data to determine possible bedrock fractures or conduits for subsurface groundwater flow. The level of effort of the geophysical investigation was to obtain seismic refraction data along six profiles, ranging from approximately 100 to 620 feet in length, to determine bedrock conditions. Geophysical data were collected and analyzed to: 1) characterize bedrock depth, configuration and velocity; and to 2) detect and map bedrock conditions.

2.0 AREA OF CONCERN 108

2.1 Area of Concern 108 Site Conditions

The site is densely vegetated with numerous boulders and fallen trees throughout the site (Image 1). Since the area is designated as wetlands, only minimal vegetation clearance was permitted. An access road in the western portion of the site, with a concrete berm paralleling both sides for a portion of the road, goes southerly from Pigeon Road. There are several large debris piles consisting of concrete footings, fence posts, and other large pieces of metal located northwest of the site.

Image 1: Area of Concern 108 – Former Naval Reserve Bivouac Area.

Elevations at the air station range from approximately 170 to 150 ft above sea level. The topography at the site slopes upward from the southwest to the northeast.

Site geology consists of bedrock overlain by overburden (glacial deposits). Bedrock consists of gneiss and granite-gneiss and has been previously determined to be shallow. Bedrock was encountered in two monitoring wells, MW10-302 and MW-304, at depths less than 20 feet below ground surface (BGS). Groundwater is also shallow at the property occurring at depths ranging from less than 5 feet to 10 feet BGS.

3.0 METHODOLOGY AND FIELD SURVEYS

3.1 Magnetic Methodology and Survey

Vertical gradient magnetic data and electromagnetic data were acquired along a site-specific data acquisition grid set up within an approximately 300 foot x 400 foot area as indicated in Figure 1. In the figure, the larger (red) dots designate the EM sampling locations and the smaller (blue) dots represent the MAG data sampling locations. The survey lines were orientated parallel to the short axis and measurement locations were collected fiducially, that is, at grid points determined by staking and marking survey line positions with wood laths, laying out 300-foot tapes, and spraying painting grid points on the ground.

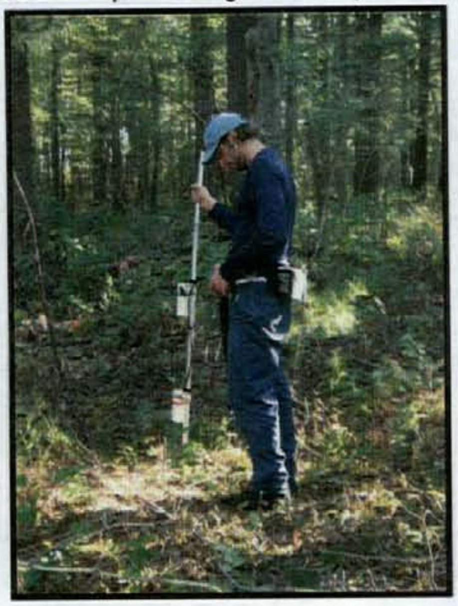


Image 2: Vertical gradient measurements were acquired using the Geometrics G858 cesium vapor magnetometer.

The MAG data were collected using a Geometrics 858 cesium vapor magnetometer in the vertical gradient mode (Image 2). The bottom sensor was positioned 8 inches above the ground surface on a staff and a second top sensor was located 2.5 feet from the ground surface directly above the bottom sensor as shown in the image. The collection of magnetic data in vertical gradient mode assists in the discrimination of discrete targets. Sensors closer to the ground are able to pick up smaller shallow objects, but are "noisier' for this reason. An upper sensor provides a means to differentiate the larger anomaly sources. Measurements were acquired at 2.5 foot intervals along survey lines spaced 2.5 feet apart.

A Geometrics G-858G magnetometer was used for this survey. The G-858G, which is an optically pumped cesium vapor instrument, measures the intensity of the earth's magnetic field in nano-Tesla (nT (1 nT = 1gamma)). During operation of the magnetometer, a direct current is used to generate a polarized monochromatic light. Absorption of the light occurs within the naturally precessing cesium atoms found in the instrument's two vapor cells. When absorption is complete, the precessing atoms become a transfer mechanism between light and a transverse radio-frequency (RF) field at a specific frequency of light known as the Larmor frequency. The light intensity is used to monitor the precession and adjusts the RF frequency allowing for the determination of the magnetic field intensity.

The earth's magnetic field, believed to originate in currents in the earth's liquid outer core, varies in intensity from approximately 25,000 nT near the equator, where it is parallel to the earth's surface, to approximately 70,000 nT near the poles, where it is perpendicular to the earth's surface. In the United States, the intensity of the earth's magnetic field varies from approximately 48,000 to 60,000 nT and has an associated inclination ranging from approximately 58 to 77 degrees.

Anomalies in the earth's background magnetic field are caused by remnant and induced magnetic fields associated with buried ferrous objects. Remnant magnetism refers to the initial magnetic field developed in an object when it was formed (e.g., when steel is cooled to create a metal pipe). Induced magnetic anomalies result from the induction of a secondary magnetic field in a ferromagnetic material (such as pipelines, drums, tanks, or well casings). Induced magnetism can be caused by long-term exposure to the earth's magnetic field or other magnetic objects, or by the sudden impact of an object.

The shape and amplitude of the magnetic signature of a ferromagnetic object depends on the geometry, size, depth, and magnetic susceptibility of the object, the magnitude and inclination of the earth's magnetic field in the study area, and the orientation and strength of the item's remnant magnetic field. Induced magnetic dipolar anomalies over buried objects such as drums, pipes, tanks, and buried metallic debris generally exhibit an asymmetrical, south high/north low signature (maximum amplitude on the south side and minimum on the north).

3.2 Electromagnetic Methodology and Survey

A Geonics EM31 Electromagnetic Terrain Conductivity Meter was used to obtain the EM data (Frequency Domain EM Data). The data were collected in the vertical dipole mode with the transmitter to receiver orientation was parallel to the survey transects (Image 3). This allowed for maneuverability in the dense vegetation encountered at the survey site. EM measurements were acquired every 5 feet along survey lines spaced 5 feet apart.

Image 3: Electromagnetic data were obtained at 5 foot sample intervals using the Geonics EM31 electromagnetic terrain conductivity meter.

Frequency Domain EM instrumentation consists of a transmitter coil and a receiver coil. An alternating current is applied to the transmitter coil, causing the coil to radiate a primary EM field, which generates eddy currents in conductive materials. These eddy currents have an associated secondary magnetic field with strength and phase shift (relative to the primary field) that are dependent on the conductivity of the medium. The combined effect of the primary and secondary fields is measured by the receiver coil. Two components of the signal are measured. Components that are both in-phase (in-phase component) and 90 degrees out-of-phase (quadrature component) are measured. The quadrature component, also referred to as terrain conductivity, is representative of the conductivity of subsurface materials in milliSiemens/meter (mS/m). The in-phase component is measured in parts per thousand (ppt), is also referred to as current density, and is generally representative of significant accumulations of buried metallic objects.

The EM31 consists of a data logger and 13-foot boom that is carried at the hip of the operator. The data logger is connected by a cable that is attached directly to the EM31 and controls and records data from the instrument. The purpose of the EM31 survey is to detect and evaluate buried ferrous-metallic and non-metallic debris.

Coordinates of the survey grid corners and wells were obtained using a Trimble Pro-XRS Global Positioning System. This information was used to translate the geophysical data from the site-specific grid to the project coordinate system during data processing.

At the end of each field day, the geophysical data sets were downloaded for QC. The data were subsequently post-processed using Geosoft's Oasis Montaj software. Final processing of the geophysical data was performed in-house upon return from the field.

3.3 Seismic Refraction Methodology and Survey

Image 4: Area of Concern 108 – Field personnel using sledge hammer for seismic source at a shot point location.

The seismic refraction method determines the seismic velocity of subsurface seismic materials as well as their thickness and configuration. Seismic velocity is affected by composition, degree of water saturation, degree of consolidation, degree of weathering and fracturing, and other physical characteristics of the subsurface materials. Igneous rocks and highly lithified sedimentary rocks (limestome, for example) typically have very high seismic velocities. Unconsolidated and unlithified sediments, colluvium, highly weathered and fractured rock etc. have lower seismic velocities.

In the seismic refraction method, data are collected along geophone arrays (spreads). Each spread is a collinear array of sensors (geophones) placed at measured intervals. Seismic energy is generated at several points along the spread (shotpoints). The time that it takes for a compressional wave (P-wave) to travel from a shotpoint to each geophone (arrival times) is recorded with a seismograph for each shotpoint. The data are stored electronically and field hard copies of the data can be generated.

The arrival times versus distance between each shotpoint and geophone are plotted on time-distance (T-D) graphs. These parameters and the actual arrival times serve as input to computer modeling programs to invert the data. The output consists of seismic velocity cross-sections showing the seismic velocity of subsurface materials as well as their depth and configuration. The cross-sections are used for geologic interpretation.

In the interpretation of the seismic refraction data, straight-line segments are fit through the arrival times whereby different seismic layers are identified and their apparent velocities are determined. Several assumptions and limiting factors should be considered when interpreting and/or applying seismic refraction information. These assumptions are inherent to the technique and are common to all interpretation routines. They are as follows:

- The seismic velocity must increase with depth. The velocity of each layer must be greater than the layers overlying it. This is usually the case in the real world. However, in some cases where velocity inversions occur, the low velocity layer is not detected and the computed depth to all layers underlying it will be erroneous.
- Specific lithologic layers will not be individually resolved unless they are of considerable thickness and their velocity contrasts with that of adjacent layers. Conversely, variation in the elastic properties of a given lithologic unit may result in two or more seismic layers.
- Unless otherwise designated, seismic layers are assumed to have a constant velocity (average velocity) along the entire length of the profile.
- Steeply dipping seismic velocity layers may cause inaccurate depth estimates.
- The computed depth to a seismic interface may not be directly below the profile. There may be a slight difference if a shallow interface dips in a direction transverse to the profile.

- The velocity of a seismic layer can differ with direction depending upon the orientation of the sedimentary structure, bedding and foliation planes, fracture patterns, etc. relative to the seismic profile. This can result in a slight discrepancy in the computed velocity and depth of seismic layers between crossing profiles.

For this project Shaw processed the data as seismic refraction tomography data using GeoTomo CTII software. The tomography processing technique creates a more locally realistic version of the subsurface and may show relative low velocity zones (weathered bedrock, fracture zones, etc.) that the traditional processing techniques may not be able to produce. Conventional processing techniques average the seismic velocity of each layer. Each layer has a single velocity and localized or small variations in that velocity are not displayed in the final product. Those variations are displayed in the tomography approach, which is superior for delineating such features.

The GeoTomo software performs nonlinear travel-time inversion, and reconstructs velocity structures from the first-arrival travel times. Through an iterative process, a reliable velocity model can be constructed that allows predicted times to fit the data. GeoTomo's tomography approach is unique. As opposed to the conventional, discrete inverse method, it applies a continuum inverse approach to invert the velocity model as a continuum space by fitting traveltime curves in 2D. As a result, the tomographic solutions are nearly independent on the initial models. The user can control the level of travel time fit by selecting a proper smoothing parameter.

Seismic refraction data were acquired along a total of six seismic lines. The final line positions were guided by an evaluation of the known local geology, air photo and topographic lineaments plots, and monitoring well borings within the property. The seismic lines were laid out on the ground so that the lines passed by or through the two borings, MW10-302 and MW-304, that encountered bedrock. These borings served as a check during the interpretation of the seismic data, and showed a good correlation with the final seismic tomographic profiles. Several geophone spreads were used to construct each profile line indicated on Figure 4. Line 1 consists of six spreads. Lines 2, 3, 4, and 5 consist of three spreads each. Line 6 is a single spread.

Each seismic spread consisted of 24 geophones located at 5 foot intervals. Five shot points were positioned along each spread. Shot points were positioned 5 foot in-line off each end of each individual spread. Shotpoints were located at the one-quarter and three quarter locations along each spread, as well as at a shotpoint at the center point. A Geometrics StrataView seismograph was used to record the seismic data. Data were recorded digitally and in hard copy form.

Coordinates of the seismic profiles and monitoring wells were obtained using a Trimble Pro-XRS Global Positioning System. Shaw took that information and translated it to a general site base map prepared for another investigation at Area of Concern 108.

4.0 RESULTS

The results from the geophysical surveys are presented as figures. All of the geophysical data shown in these figures have also been provided digitally as georeferenced tiff images. A site basemap has been superimposed on the geophysical data, including any surface features that were encountered during the survey. Additionally, the locations of the target picks provided for field verification prior to demobilization are also displayed on the figures.

Image 5: Culvert beneath access road intersecting with Pigeon Road.

4.1 Magnetic Survey Results

The magnetic survey results are presented as Figures 2a-2c. Figure 2a is the total magnetic field measurements from the bottom sensor data. Figures 2b & 2c present the measurements obtained from the bottom and top magnetic sensors as the analytic signal. Analytic signal represents the square root of the sum of the squares of the derivatives in the x, y, and z directions. It is utilized for easier interpretation as it turns total field dipolar anomalies into monopolar anomalies.

As evidenced on the maps, analysis of the magnetic data reveals numerous anomalies throughout the site. A culvert is present at the intersection of Pigeon Road and the access road to the north (Image 5). Debris piles consisting of metal fence posts, concrete footings, and other types of scrap were encountered to the southeast of the culvert (Targets 14, 15, 21, and 22). A large debris pile, Target 38, is also evident in the northwest central portion of the figures. Data associated with the three monitoring wells are identified as peak responses and are noted on the map. Additional anomalies of varying signal strength and size are seen to be scattered across the site.

4.2 EM31 Survey Results

Figures 3a & 3b presents the conductivity (mS/m) and in-phase (ppt) measurements acquired during the electromagnetic survey. Variability in background levels can be attributed to differing soil conditions and soil saturation following heavy rains, which was the situation from earlier in the week.

Both the in-phase and conductivity data sets reveal anomalies that can be associated to the surface items mentioned in the previous section. However, inspection of the maps reveal some additional anomalies, such as Targets 141, 145, and 153, that were also added to the target list and selected for field verification.

4.3 Preliminary Magnetic and Electromagnetic Target Picks

During the second week of the geophysical field activities, targets were picked from the preliminary EM and magnetic data sets and provided for further field verification. The area was then walked and each target location relocated. These targets are presented on the figures and listed with the field verification results in Table 1.

Image 6: One of the debris piles located in the northwest central portion of the site.

It can be seen that, aside from the surface debris items as exhibited in Image 6, many of the anomalies encountered are correlated to surface and near-surface metamorphic and igneous boulders. Additional target associations have been made with the concrete berms alongside the road, telephone poles, and other near-surface objects containing metallic components. Some of the extremely low amplitude anomalies as observed in the magnetic data have been correlated to trees and/or stumps. There is likely an associated boulder in the vicinity of the trees.

Eighteen anomalies did not have an associated surface item; therefore, they are likely caused by buried objects and debris. Those anomalies could be excavated for verification of the source of each anomaly.

4.4 Seismic Refraction Survey Results

Figure 4 indicates the location of all seismic refraction profiles at the AOC 108 Site. The locations of these profiles were acquired using a Trimble Pro XRS GPS system. The surrounding features were taken off of a another site map. Most of the area of investigation is located southerly of the site where Shaw conducted EM and MAG surveys.

Image 6: Picture of Seismic Refraction equipment near monitoring well for calibration of seismic data with well

The results from the seismic refraction survey is presented in Figures 5 through 10. These figures indicate the distribution and configuration of seismic velocities along each profile.

The profiles display some differences in the velocities and depths of each layer when correlated at the profile intersections. These difference are an indication of the type of bedrock at this site, that is, the layered nature (foliation) of the metamorphic bedrock (gneiss and granite-gneiss). Depending on the direction (azimuth) of the seismic refraction survey, the seismic energy will move at different velocities, which is a reflection of the continuous nature of the bedrock. For example, seismic energy will have a higher velocity along the direction of the foliation due to the continuous condition of the rock, that is, relatively fewer separations (apertures) along the foliation planes.

In general, the subsurface seismic velocities form three main layers. Layer 1 is a surficial layer that ranges from approximately 1100 feet per second (fps) to 2400 fps (blue colors). These velocities are typical of dry to slightly moist organic materials, surface soils, and near-surface sediments. These materials range from 5 to 10 feet in thickness.

Layer 2 velocities are approximately 4,000 to 6,000 fps (green to yellow colors). Since the velocity of water is 4,800 fps, Layer 2 represents saturated sediments. This layer represents the unconfined aquifer. Sediments within the aquifer are unconsolidated to partially-consolidated. Any consolidation of sediments increases the seismic velocity as is evidenced in the bottom velocities in Layer 2 (orange colors), which is a common occurrence in basal glacial deposits overlying bedrock. The groundwater surface is interpreted to occur between 5 and 10 feet BGS according to these profiles. The upper part of Layer 2 (lowest velocities) likely represents the capillary fringe of the water table.

Layer 3 velocities are approximately 7,000 fps to 12,000 fps. The higher velocities represent hard unweathered gneissic and granitic bedrock. The lower velocities likely represent weathered and/or fractured bedrock. Several variations in the bedrock velocity are evidenced on the cross-sections indicating variations in bedrock conditions. These variations are flat lying low-velocity zones that cover the bedrock surface and likely represent the weathered horizon. Some small localized relatively lower-velocity zones occur in the bedrock (Profile 2 – 320 mark, Profile 3 – 300 mark, Profile 6 – 110 mark). These may be small localized low velocity zones; however, the bedrock surface will still be encountered at shallower depths. The highest velocities (pink colors) represent hard, sound bedrock.

5.0 CONCLUSIONS

5.1 Magnetics and Electromagnetics

The results of the geophysical surveys, and subsequent field verification, reveal that the significantly large anomalies, possible sources of subsurface contamination, are found to the north and northwest within the surveyed area. These anomalies are associated with surface scrap and metal debris. The presence of these surface items may mask additional targets buried at depth.

Many of the other anomalies, the majority of which are observable only in the magnetic data, may be attributed to boulders of igneous or metamorphic origin containing a few percent ferromagnetic minerals. However, if the boulders do not have any ferromagnetic component the anomalies may be caused by buried ferrous items in proximity. It is likely that the boulders are the cause of the anomalies. Eighteen anomalies have no surface explanation.

5.2 Seismic Refraction

The seismic refraction data at the AOC 108 correlated well with the geology interpreted from the borehole information. The water table and bedrock interface occurred on the profiles at depths and velocities that are consistent with earlier observations.

In general, the bedrock surface is 15 to 20 feet deep and has a weathered zone that differs in thickness and degree of soundness. The velocities within that weathered zone are gradational, as expected for gneissic or granitic bedrock. Some localized zones (especially along Profiles 2 and 3 on the west side) exhibit an interpreted deeper weathered zone. However, the bedrock interface will still be encountered at a depth of slightly over 20 feet. In general, no large obvious and extensive fracture zones appear in the seismic data that extend between profiles.

FIGURES

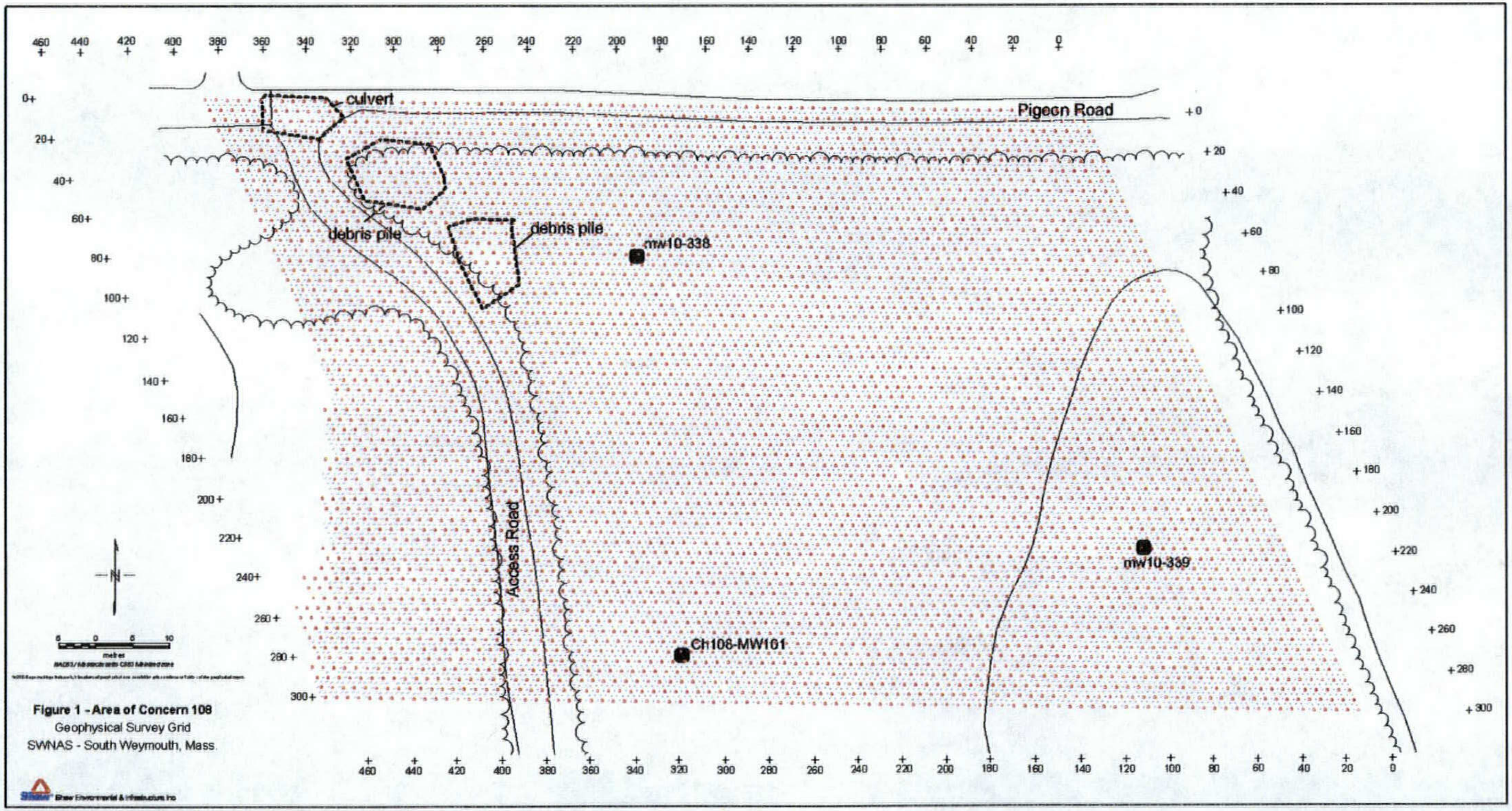


Figure 1 - Area of Concern 108
Geophysical Survey Grid
SWNAS - South Weymouth, Mass.

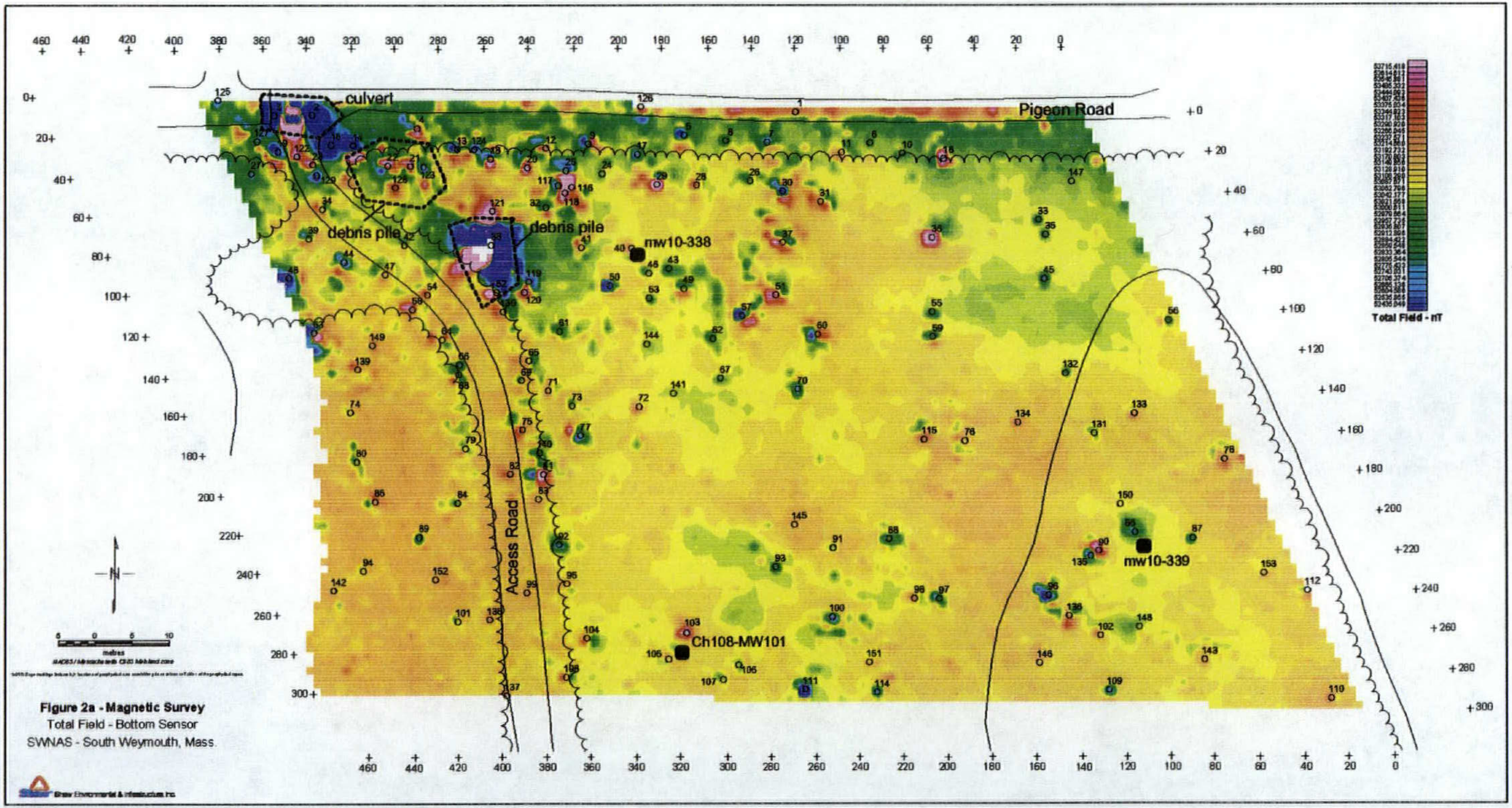


Figure 2a - Magnetic Survey
Total Field - Bottom Sensor
SWNAS - South Weymouth, Mass.

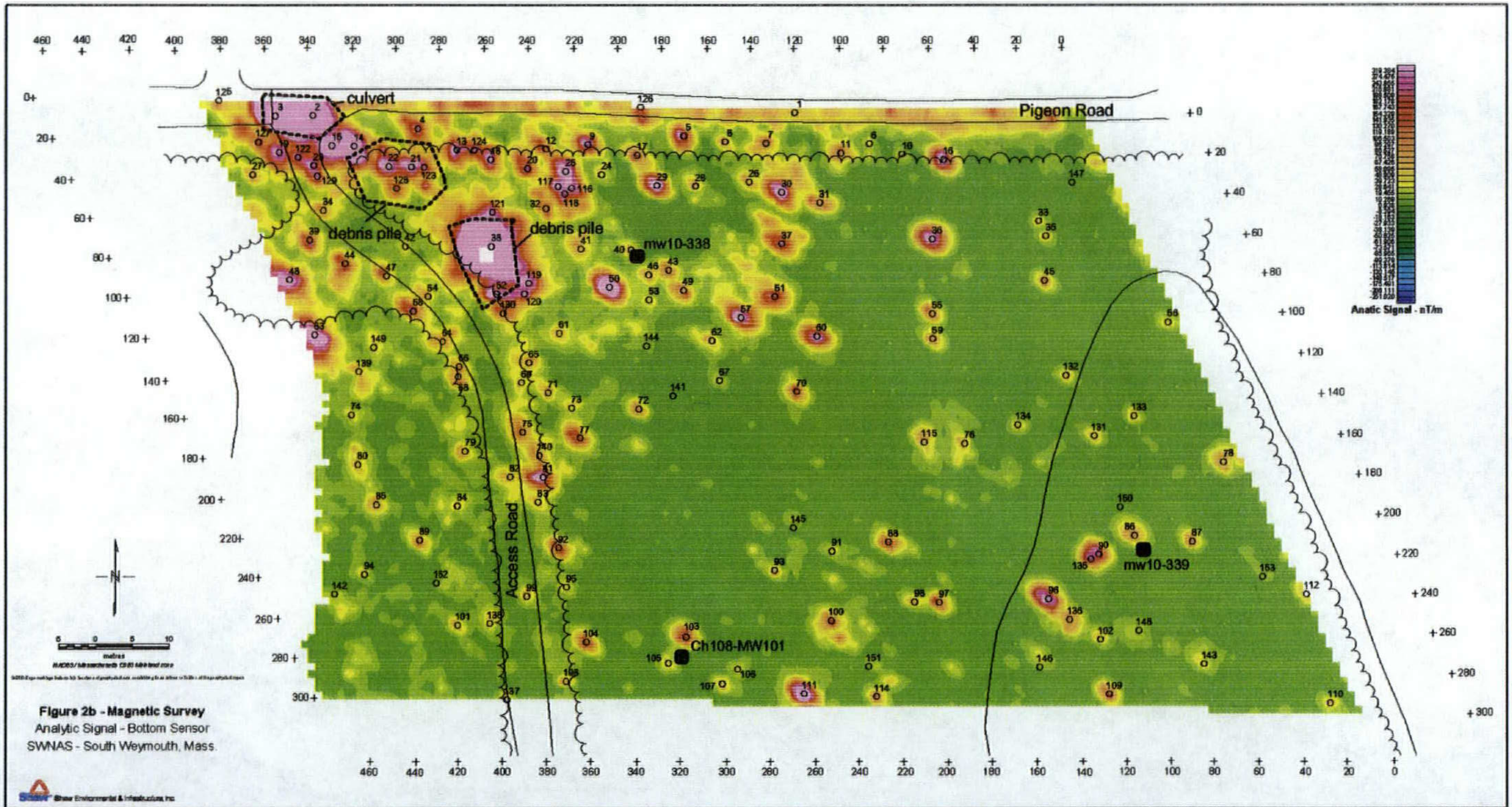


Figure 2b - Magnetic Survey
Analytic Signal - Bottom Sensor
SWNAS - South Weymouth, Mass.

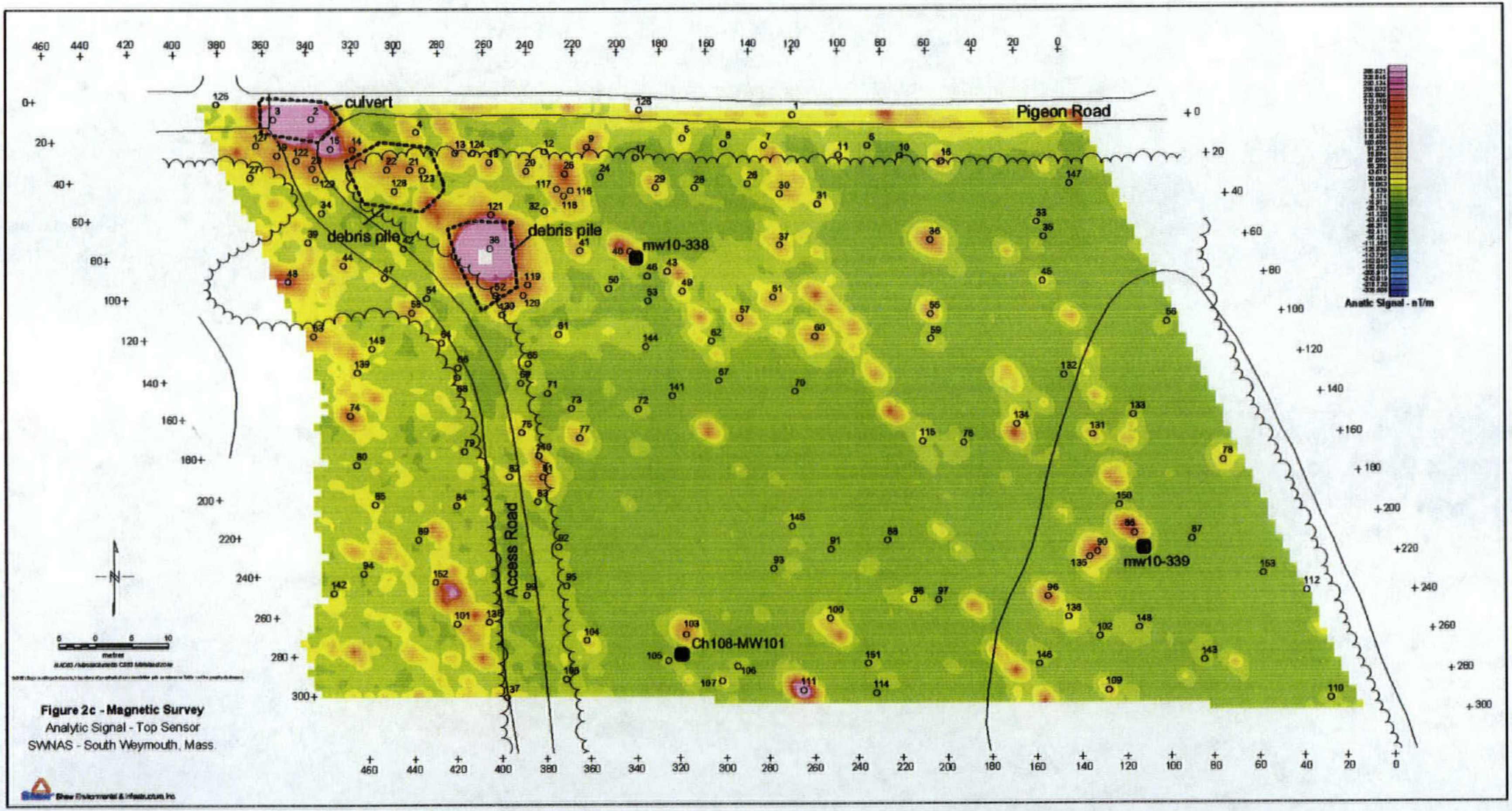


Figure 2c - Magnetic Survey
Analytic Signal - Top Sensor
SWNAS - South Weymouth, Mass.

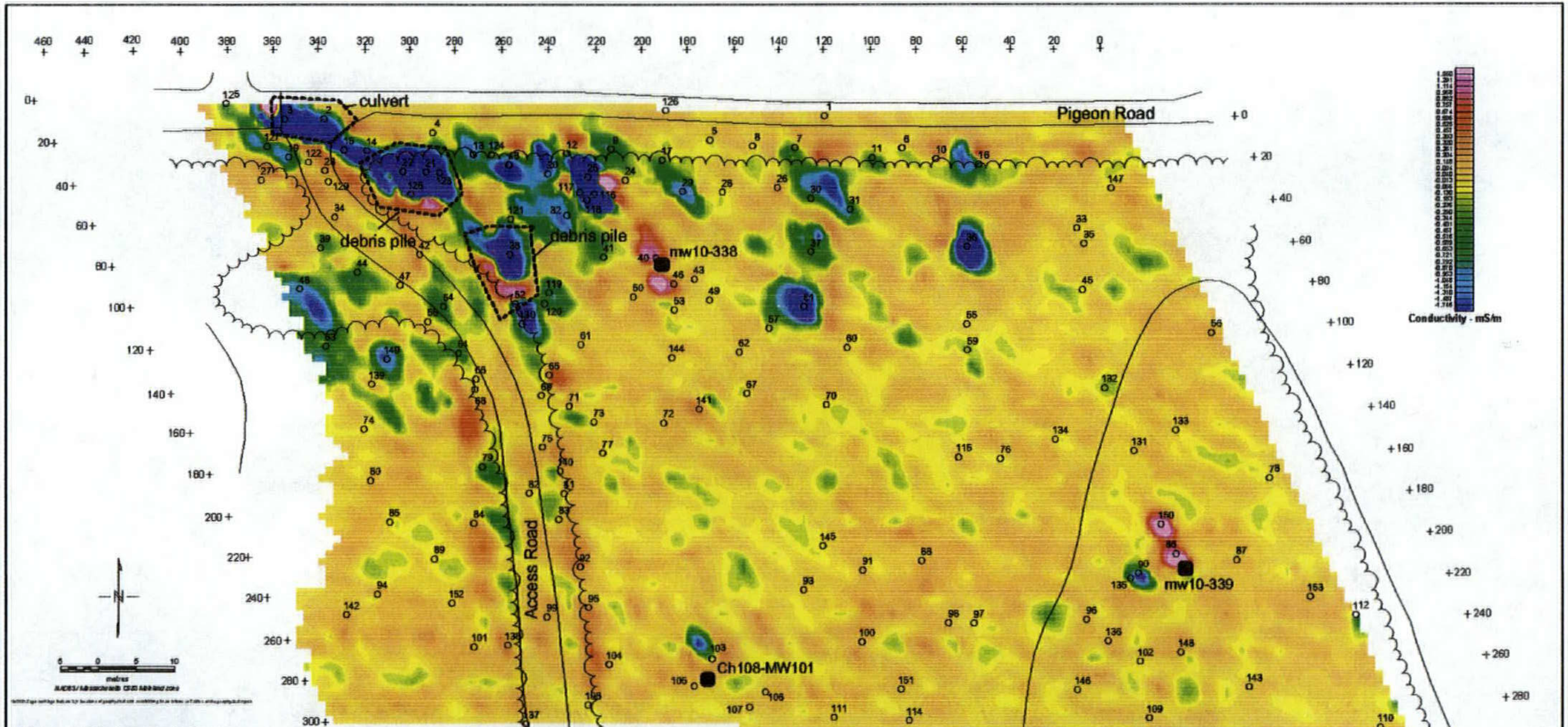


Figure 3a - Electromagnetic Survey
Conductivity
SWNAS - South Weymouth, Mass.

Shaw Environmental & Infrastructure, Inc.

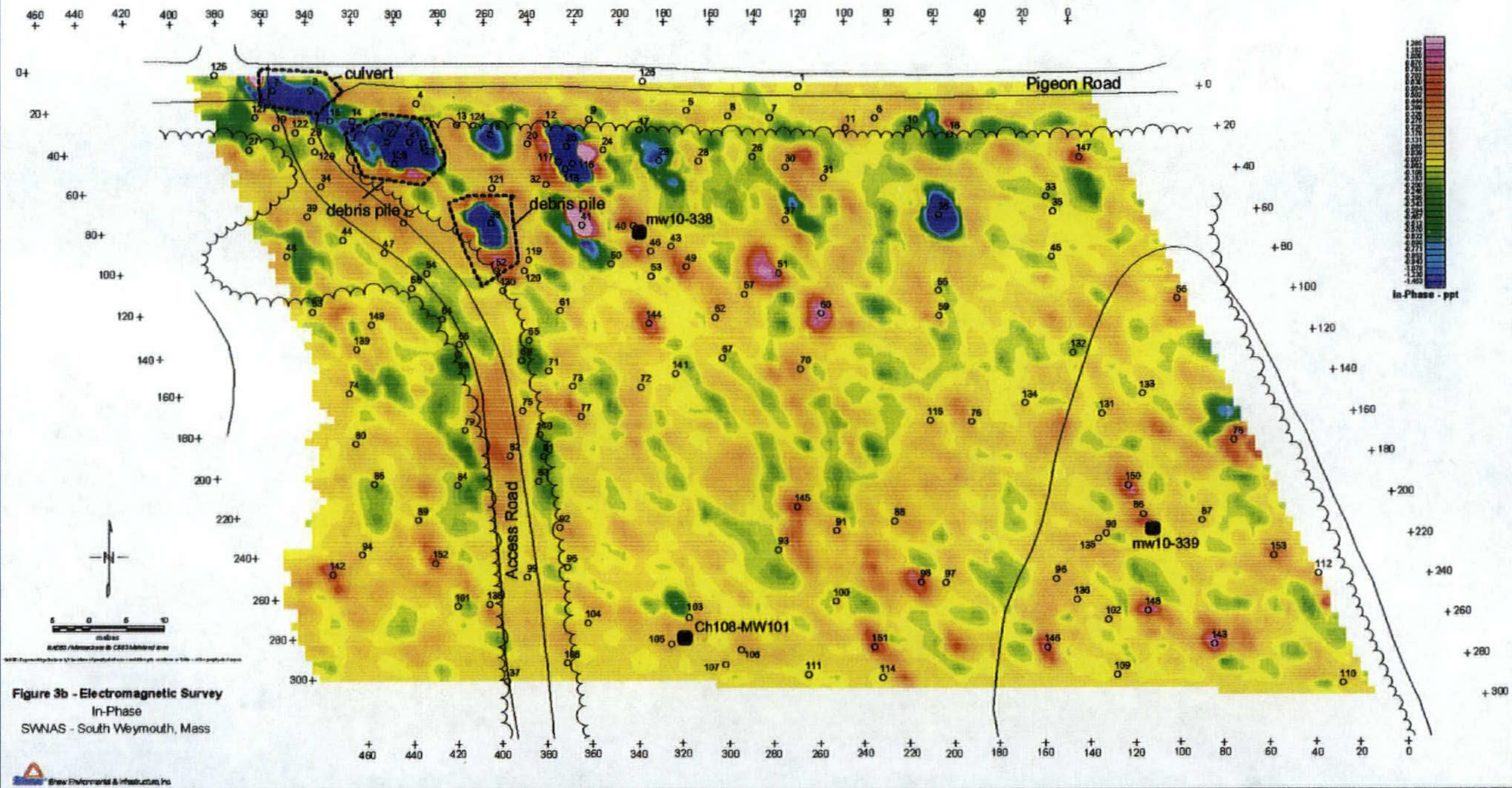


Figure 3b - Electromagnetic Survey
In-Phase
SWNAS - South Weymouth, Mass

Legend

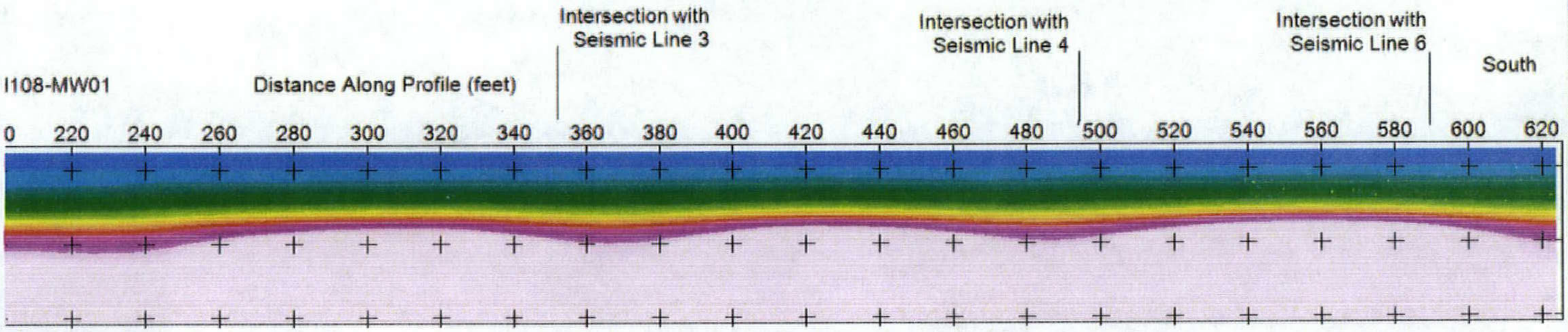
- Seismic End Point
- Monitoring Well
- Seismic Lines
- Treeline
- Roads
- Outline of EM and Mag Survey

Shaw
Shaw E & I, Inc.

South Weymouth Naval Air Station

Figure 4 - Area of Concern 108
Site Location Map

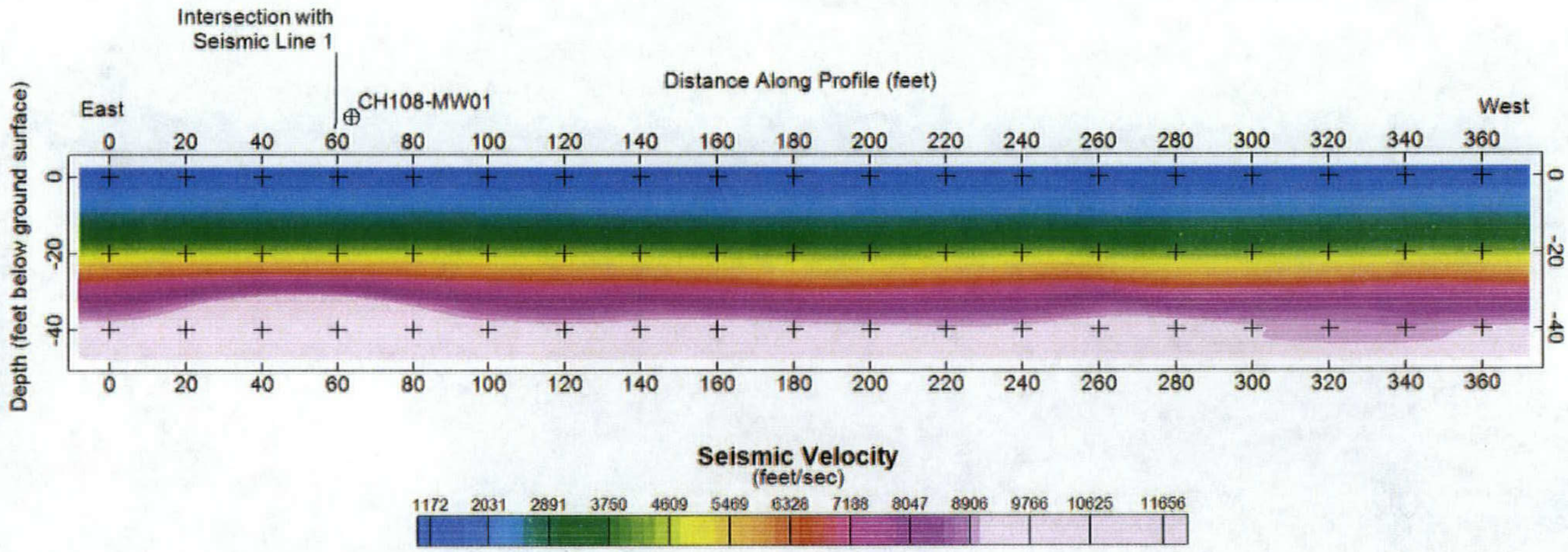
Note: Geophysical data points are to scale, but surrounding areas are not to scale



South Weymouth Naval Air Station

Figure 5
Seismic Profile 1

No Vertical Exaggeration (1:1)

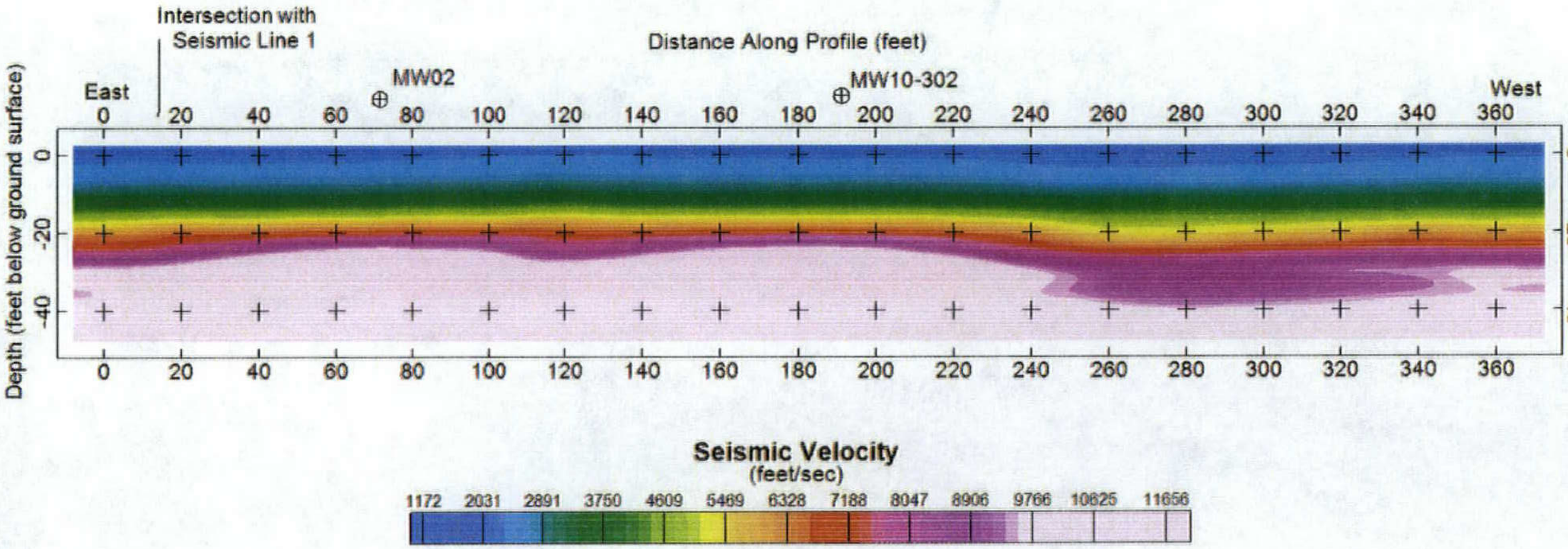


Shaw Environmental & Infrastructure, Inc.

South Weymouth Naval Air Station

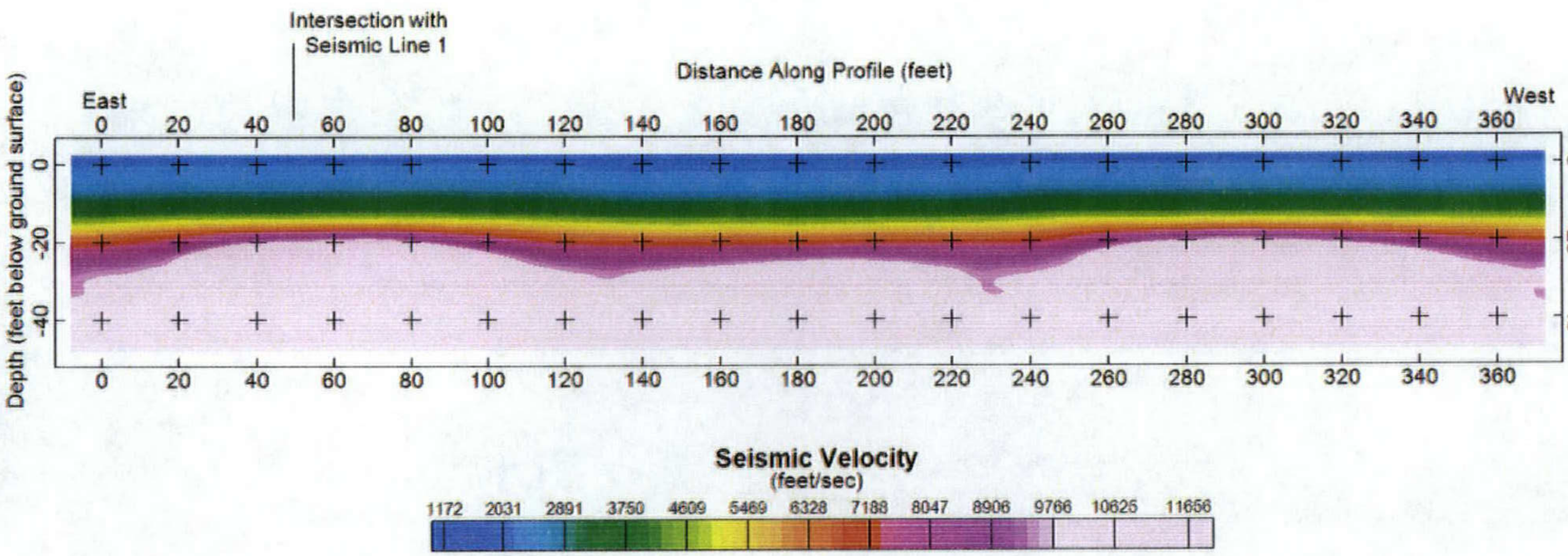
Figure 6
Seismic Profile 2

No Vertical Exaggeration (1:1)



Shaw
Shaw Environmental & Infrastructure, Inc.

South Weymouth Naval Air Station
Figure 7   **Siesmic Profile 3**
No Vertical Exaggeration (1:1)

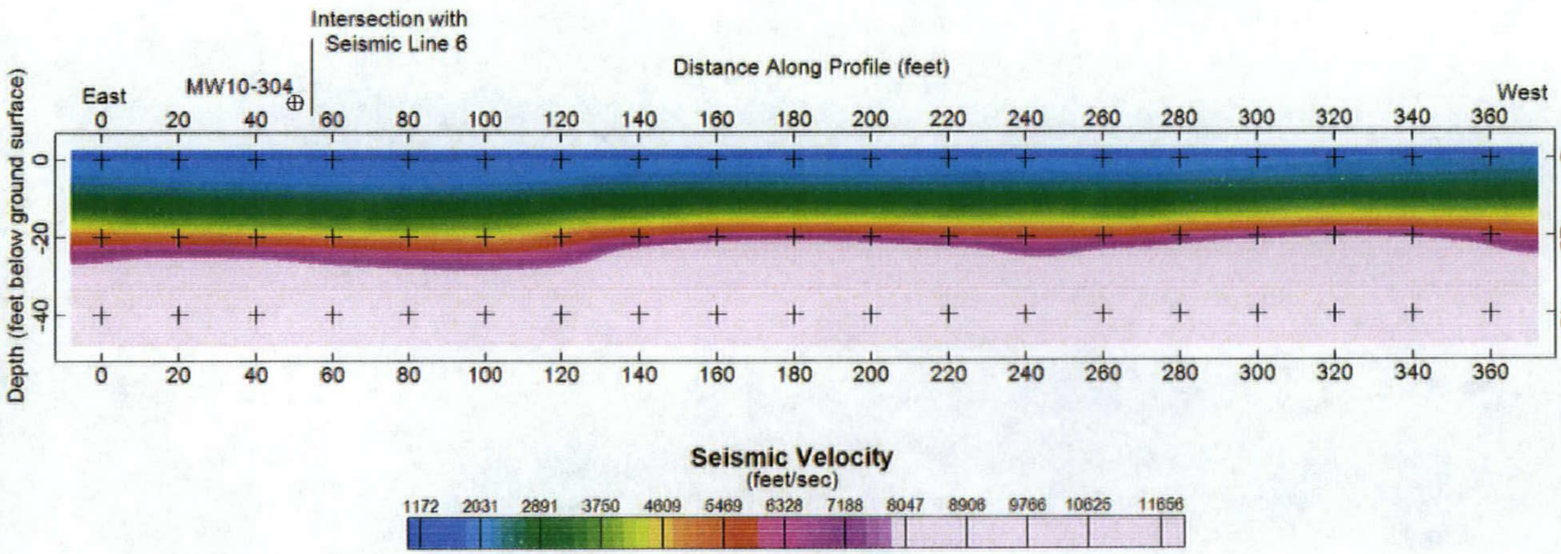


Shaw Environmental & Infrastructure, Inc.

South Weymouth Naval Air Station

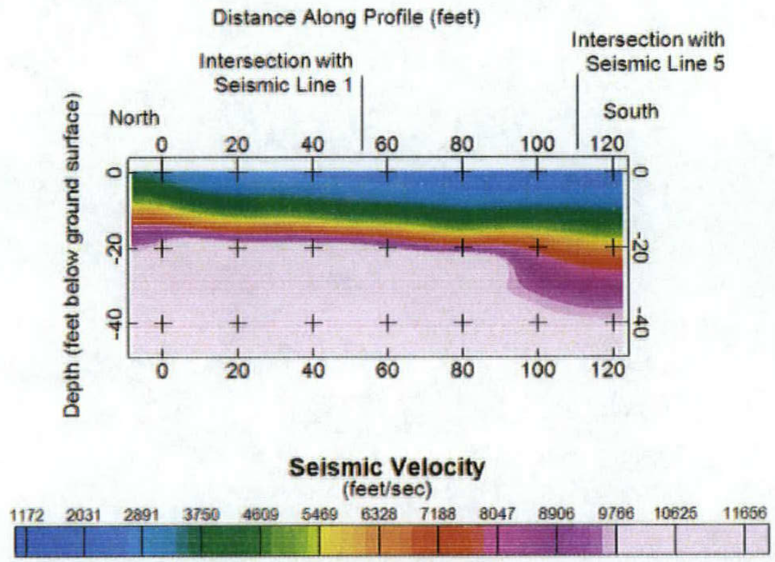
Figure 8
Seismic Profile 4

No Vertical Exaggeration (1:1)



Shaw Environmental & Infrastructure, Inc.

South Weymouth Naval Air Station
Figure 9 **Seismic Profile 5**
No Vertical Exaggeration (1:1)



Shaw
Shaw Environmental & Infrastructure, Inc.

South Weymouth Naval Air Station

Figure 10
Seismic Profile 6

No Vertical Exaggeration (1:1)

TABLE 1
FIELD VERIFICATION and RESULTS

Geophysical Target Field Verification Spreadsheet and Results
S uth Weymouth Naval Air
Station
Area f Concern 108 - Former Naval Reserve Bivouac Area
Oct-04

	Survey Grid Location (ft)		Mass. Mainland NAD83 (meters)		
Target_ID	**X**	**Y**	**E**	**N**	**Verification Results**
1	130	2.5	246533.6	878970	metal debris
2	350	7.5	246467.1	878969.6	culvert
3	367.41	8.04	246461.8	878969.6	culvert
4	304.66	13.4	246481.7	878967.8	metal debris
5	185	15	246518.4	878966.8	no surficial anomaly observed
6	102.5	17.5	246543.9	878965.8	trees
7	149.31	18.04	246529.7	878965.8	metal debris
8	167.5	17.5	246524.1	878966.1	metal debris
9	230	20	246505.3	878965.6	trees
10	90	22.5	246548.4	878964.3	Boulder
11	117.5	22.5	246540	878964.5	old shoe, pavement
12	250	22.5	246499.5	878965.1	Boulder
13	290.68	23.65	246487.2	878964.9	metal debris
14	337.5	22.5	246472.8	878965.4	metal debris
15	347.5	22.5	246469.7	878965.5	cinder block
16	72.5	25	246554	878963.6	Boulder
17	210	25	246512	878964.2	cinder blocks, pavement
18	277.38	28.32	246491.9	878963.6	toe of mound
19	373.2	26.24	246462.4	878964.6	diskette
20	262.5	32.5	246497	878962.4	toe of mound
21	315.62	32.53	246480.8	878962.6	telephone pole
22	325.9	32.52	246477.6	878962.6	telephone pole
23	360	32.5	246467.2	878962.8	gate post
24	230	35	246507.2	878961.5	Large Boulder
25	245.66	33.68	246502.3	878962	Boulder
26	165	37.5	246527.4	878960.5	metal debris
27	390	37.5	246458.7	878961.6	metal debris
28	190	40	246520.1	878960	Boulder
29	207.5	40	246514.7	878960.1	no surficial anomaly observed
30	152.5	42.5	246531.8	878959.1	no surficial anomaly observed
31	137.5	47.5	246537.1	878957.7	Boulder below grade
32	262.5	52.5	246499.5	878956.9	mound
33	42.5	55	246567	878955.2	stumps, pile of cut wood
34	365	55	246468.5	878956.6	no surficial anomaly observed
35	42.5	62.5	246568	878953.1	stumps, pile of cut wood
36	94.28	64.94	246552.5	878952.7	Large Boulder subsurface
37	163.33	68.43	246531.8	878952	no surficial anomaly observed
38	295.3	71.91	246492	878951.7	concrete anchors with steel columns

G ophysical Targ t Fi ld Verificati n Spreadsheet and R ults
South Weymouth Naval Air Station
Area f Concern 108 - Former Naval Reserve Bivouac Area
Oct-04

	Survey Grid Location (ft)		Mass. Mainland NAD83 (meters)		
Target_ID	**X**	**Y**	**E**	**N**	**Verification Results**
39	377.5	70	246466.6	878952.6	metal debris
40	232.5	72.5	246511.2	878951.2	close to well
41	255	72.5	246504.4	878951.3	three large boulders with rairoad tie
42	335	72.5	246479.9	878951.7	center of road
43	220	82.5	246516.3	878948.4	close to well
44	366.21	81.52	246471.6	878949.4	road berm
45	52.5	85	246567.8	878947	stumps, pile of cut wood
46	230	85	246513.6	878947.8	well MW10-338
47	350	87.5	246477.3	878947.6	concrete
48	395	90	246463.8	878947.2	metal debris
49	217.5	92.5	246518.4	878945.7	trees
50	250.09	91.53	246508.3	878946.1	three large boulders with rairoad tie
51	177.5	95	246530.9	878944.8	metal bucket
52	302.81	95.73	246492.7	878945.2	steel pipe
53	235	97.5	246513.7	878944.4	close to well
54	335	97.5	246483.1	878944.8	concrete below grade
55	110	102.5	246552.5	878942.4	trees, stumps
56	5	105	246584.8	878941.3	Large Boulder
57	197.15	105.76	246526.3	878941.9	no surficial anomaly observed
58	345	105	246481	878942.8	telephone pole
59	115	115	246552.5	878939	stumps
60	166.83	114.62	246536.6	878939.4	Boulder below grade
61	282.5	115	246501.4	878939.8	pile of rocks
62	215	117.5	246522.3	878938.8	trees
63	395	117.5	246467.3	878939.6	pavement, concrete, cinder blocks
64	337.5	120	246485.2	878938.7	telephone pole
65	302.5	130	246497.2	878935.8	metal debris
66	335	132.5	246487.6	878935.2	road berm
67	220	137.5	246523.3	878933.3	no surficial anomaly observed
68	337.5	137.5	246487.4	878933.9	road berm
69	310	140	246496.2	878933	road berm
70	187.5	142.5	246533.9	878931.8	pile of rocks
71	300	145	246499.9	878931.6	rebar in concrete
72	262.5	152.5	246512.3	878929.4	pile of rocks
73	292.5	152.5	246503.1	878929.5	rebar in concrete
74	395	157.5	246472.4	878928.6	telephone pole
75	320	165	246496.3	878926.2	road berm
76	122.5	167.5	246556.9	878924.6	trees
77	295	167.5	246504.2	878925.4	pile of rocks

Geophysical Targ t Fi ld V rification Spreadsheet and R ult
S uth Weymouth Naval Air
Station
Area of Concern 108 - Former Naval Reserve Bivouac Area
Oct-04

	Survey Grid Location (ft)		Mass. Mainland NAD83 (meters)		
Target_ID	**X**	**Y**	**E**	**N**	**Verification Results**
78	9.16	174.99	246592.5	878922.1	Large Boulder
79	350	175	246488.4	878923.6	road berm
80	402.5	182.5	246473.3	878921.8	Boulder
81	320	187.5	246499.2	878920	no surficial anomaly observed
82	335	187.5	246494.6	878920.1	center of road
83	327.5	200	246498.5	878916.6	road berm
84	365	202.5	246487.3	878916.1	road berm
85	402.5	202.5	246475.9	878916.3	Boulder
86	65	212.5	246580.2	878912	well MW10-339
87	40	215	246588.2	878911.2	Boulder 3 inches below grade
88	177.5	217.5	246546.5	878911.2	Boulder
89	390	220	246481.9	878911.4	Boulder
90	85.44	222.1	246575.2	878909.5	stumps, boulders, metal debris
91	205	222.5	246538.7	878909.9	Boulder
92	327.77	222.81	246501.3	878910.4	pile of rocks
93	235	232.5	246530.8	878907.3	Large tree on SL-3
94	422.5	237.5	246474.2	878906.8	Boulder 2 inches below grade
95	332.5	242.5	246502.3	878905	surficial rocks
96	117.5	245	246568.3	878903.3	stump mound
97	167.5	247.5	246553.4	878902.9	no surficial anomaly observed
98	178.51	247.51	246550	878902.9	Boulder
99	352.5	247.5	246496.9	878903.7	center of road
100	220	257.5	246538.6	878900.4	Boulder
101	390	262.5	246487.3	878899.8	no surficial anomaly observed
102	102.5	265	246575.4	878897.8	boulder below grade
103	289.05	266.66	246518.7	878898.2	well (CH-MW-01)
104	335	270	246505.1	878897.4	no surficial anomaly observed
105	302.5	280	246516.3	878894.6	down trees
106	272.5	282.5	246525.8	878893.7	Boulder
107	282.5	290	246523.7	878891.7	no surficial anomaly observed
108	352.5	290	246502.3	878892	road berm
109	110	292.5	246576.7	878890.3	stumps
110	11.51	295.11	246607.1	878889.1	no surficial anomaly observed
111	247.53	294.4	246534.9	878890.4	no surficial anomaly observed
112	-0.62	240.65	246603.8	878904	Large Boulder
114	215.29	295.28	246544.9	878890	trees
115	140.6	167.14	246551.3	878924.8	trees
116	246.55	42.06	246503.1	878959.7	Boulder

G ophysical Targ t Fi ld V rificati n Spr adsheet and R ults
S uth Weymouth Naval Air
Station
Area f Concern 108 - Former Naval Reserve Bivouac Area
Oct-04

	Survey Grid Location (ft)		Mass. Mainland NAD83 (meters)		
Target_ID	**X**	**Y**	**E**	**N**	**Verification Results**
117	252.38	41.36	246501.2	878959.9	toe of mound, excavated 18 inches below grade: glass, cinders
118	250.75	44.86	246502.1	878958.9	toe of mound
119	285.97	90.11	246497.1	878946.6	rocks
120	290.17	95.47	246496.5	878945.2	pile of rocks
121	287.6	54.65	246492.1	878956.4	mound
122	365.51	28.53	246465	878963.9	concrete
123	309.76	32.73	246482.6	878962.5	telephone pole
124	282.94	23.63	246489.6	878964.9	concrete
125	389.99	0.75	246454	878971.7	no surficial anomaly observed
126	198.48	0.98	246512.5	878970.7	no surficial anomaly observed
127	380.66	21.27	246459.5	878966	metal debris
128	327.01	43.43	246478.7	878959.6	telephone pole
129	360.6	37.83	246467.7	878961.3	gate post
130	303.91	105.48	246493.6	878942.5	steel in road berm
131	62.51	162.65	246574.6	878925.7	stumps, pile of cut wood
132	62.75	132.56	246570.7	878934	stumps, pile of cut wood
133	40.12	152.39	246580.1	878928.4	Boulder
134	94.7	157.75	246564.2	878927.2	trees
135	90.04	224.7	246574.1	878908.8	stumps, boulders
136	112.43	255.26	246571.2	878900.5	no surficial anomaly observed
137	383.22	299.6	246494.1	878889.5	road berm
138	375.06	261.35	246491.8	878900	center of road
139	382.54	135.64	246473.5	878934.6	telephone pole
140	317.23	176.69	246498.6	878923	road berm
141	244.25	145.56	246516.9	878931.2	Boulder
142	440.29	247.62	246470.1	878904.1	Large Boulder
143	60.38	276.52	246589.8	878894.4	Boulder
144	245.75	120.74	246513.3	878938	Boulder
145	217.56	210.97	246533.4	878913.1	stump pile (SL-2)
146	135.8	279.34	246567.1	878894	Boulder
147	19.5	35.46	246571.5	878960.5	Large Boulder
148	82.93	260.3	246580.8	878899	Boulder
149	370.75	123.39	246475.5	878937.9	cinder block, railroad ties
150	65.64	198.26	246578.2	878915.9	Boulder
151	212.54	280.18	246543.8	878894.1	no surficial anomaly observed
152	391.23	241.34	246484.3	878905.6	Boulder
153	15.5	232.16	246597.8	878906.4	Large Boulder